



ANNUAL REPORT

OF THE

SUDAN VETERINARY SERVICE

1938.

With the compliments of
The Director
Veterinary Service, Sudan Government,
Khartoum.



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	No of ::	No. of cattle
	Outbreaks:	involved
Existing at end of month	8	3248
Add :-		
Fresh during month (as reported above	10	1834
T o t a l	18	5082
Deduct :-		
Suppressed during month	5	1469
D e a t h s :-		95
		1564
Existing at end of month	13	3518

W. H. H.

for DIRECTOR, VETERINARY SERVICE.

H.

Director,
Bureau Hygiene & Tropical Disease,
Kepple Street,
Gower Street,
London W.C.



ANNUAL REPORT
OF
THE SUDAN VETERINARY SERVICE
FOR THE YEAR 1938



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S T A F F

DISTRIBUTION OF BRITISH STAFF ON 31ST DECEMBER, 1938.

NAME	DESIGNATION	STATION
Captain H.B. Williams, O.B.E., M.R.C.V.S.	Director	Khartoum
Dr. S.C.J. Bennett, D.Sc., M.R.C.V.S.	Asst. Director and Senior Research Officer	Khartoum
Mr. J.T.R. Evans, B.Sc., M.R.C.V.S.	Veterinary Research Officer	Malakal
Captain C.P. Fisher, M.R.C.V.S.	Senior Veterinary Inspector	Khartoum
Captain T. Menzies, M.R.C.V.S. D.V.S.M.	"	El Fasher
Captain L.E. Prichard, C.B.E., M.R.C.V.S.	"	Wad Medani
Mr. W.H. Glanville, M.R.C.V.S.	Veterinary Inspector, Head- quarters and Registrar, Veterinary School	Khartoum
Mr. J.E. Furney, M.R.C.V.S.	Veterinary Inspector	Kassala
Mr. J.A. Gillespie, M.R.C.V.S.	"	El Obeid
Mr. A.W. Chalmers, M.R.C.V.S.	"	Kosti
Mr. P. Durran, M.R.C.V.S.	"	Shendi
Mr. J.D.M. Jack, M.R.C.V.S.	"	Malakal
Mr. J.K. Thomson, M.R.C.V.S., D.V.S.M.	"	Wad Medani
Mr. H. Kieran, M.R.C.V.S.	"	En route from U.K.
Mr. H.A. McLoghry	Superintendent	Khartoum
Mr. P.A.C. Kenny, F.R.M.S.	Laboratory Assistant	Khartoum
Mr. C.B. Barrett	Chief Storekeeper	Khartoum

The field staff was sadly depleted during the year by the departure on pension of two of our most senior Inspectors, Captain J. Going and Major J.R. Ellison, and by the retirement of Mr. R.H.A. Merlen.

Captain J. Going was seconded to the Egyptian Army in the Sudan from the Royal Army Veterinary Corps in July, 1918. In 1925 he resigned his commission in order to join the newly formed Sudan Veterinary Service. His sterling qualities and open personality endeared him to all he came in contact with. He delighted in his work and had the welfare of the Sudanese and their animals at heart. His departure is a great loss to this Service.

Major J.R. Ellison first came to this country in August, 1918, on secondment to the Egyptian Army. On retiring from the Royal Army Veterinary Corps in 1928 he joined the permanent staff of the Sudan Veterinary Service. Of a genial personality this efficient official served in all Provinces. Particular mention may be made of the success he made of the training centre at Malakal, which is a bright spot in our Animal Husbandry endeavours in the Upper Nile. Here Dinkas and Nuers are taught and demonstrated up-to-date methods of flaying and hide preparation.

It was only found possible to fill two of the three vacancies caused by the retirement of Veterinary Inspectors. The selected were Mr. J.K. Thomson, who arrived in December and was posted to Blue Nile Province, and Mr. H. Kieran, who is expected in early January and will be posted to Kordofan Province.

Captain C.P. Fisher was posted to Khartoum in relief of Captain J. Going, retired, and his place at El Obeid was taken by Mr. J.A. Gillespie, who in turn was relieved at Kassala by Mr. J.E. Furney from Wau; the post of Veterinary Inspector, Equatoria Province, being abolished. Mr. J.D.M. Jack was transferred from El Obeid to Malakal in relief of Major J.R. Ellison, retired.

The Director carried out extensive tours in all Provinces in company with the respective Province Veterinary Inspectors. These tours were undertaken during the March to June period so that animals thought to be living in overstocked areas could be seen when grazing and watering conditions were at their worst.

SECTION IDISEASES OF ANIMALS.I. DISEASES OF CATTLECattle Plague

All Provinces remained infected but nowhere did the disease assume epizootic proportions. The value of the prophylactics supplied to combat this disease is now fully appreciated by all Arab cattle owners in the Northern Sudan and only once had action to be taken in the case of an unreported outbreak. The complete confidence of the people was finally gained through the creation by Tribal Administrations of numerous posts on their staffs for veterinary tribal retainers. These retainers, selected from the animal-owning tribesmen, were trained at provincial veterinary headquarters in disease control and animal husbandry and then returned to their tribes for permanent duty. This has resulted in a close liaison between the Veterinary Service and the cattle owners. Whereas in the early days of disease control, when response to propaganda on the benefits of prophylactics for cattle plague appeared slow, there was sufficient serum and vaccine to meet all demands, now that disease is spontaneously reported, and all owners of infected and incontact herds want their animals treated, Veterinary Inspectors are faced with the difficulty of how to distribute their supplies (which are frequently insufficient to meet all demands) to the best advantage. Data on the carrying capacity of certain areas is gradually being obtained and, also, on the economic use to which cattle and their products are being put. It will be largely on an assessment of these factors that the distribution of prophylactics will in future take place.

Returns of treated outbreaks for 1938 show that 896 outbreaks occurred, involving 319,945 head of cattle, of which 85,662 were serumised and 54,180 vaccinated. That the disease present was of a mild nature is shown by the small number of deaths which occurred in these outbreaks - the total being 4,942.

In addition to the 54,180 doses of cattle plague vaccine used in connexion with the above outbreaks, 63,151 doses were given prophylactically for the immunising of trade cattle and dairy herds, and as a means of localising outbreaks by creating a ring of immune cattle round infected areas. In some instances, too, vaccine was given to induce owners to adopt improved methods of animal industry, such as drying of hides by the suspension method.

Contagious Bovine Pleuro-Pneumonia

Contagious bovine pleuro-pneumonia occurred chiefly in herds of trade cattle. The Veterinary Inspector, Kordofan Province, reports as follows :-

"This disease is constantly present in
 "traders' cattle. Deaths from it are now always
 "reported by them. Reports from various
 "sources reveal that considerable casualties
 "from this disease have been sustained in herds
 "travelling to Kosti. The merchants deny any
 "great losses, but they are obviously afraid
 "of repercussions and tend to be reserved.
 "The disease as it occurs in local cattle is
 "reported for the most part on routes and
 "grazing areas frequented by trade cattle."

With the exception of those cases which occurred amongst trade cattle in the chain of export quarantines, Khartoum and Kassala Provinces remained free of disease throughout the year. Reports from White Nile and Blue Nile Provinces point to outbreaks within their borders having been caused by the passage onwards of the trade cattle referred to by the Veterinary Inspector, Kordofan, to markets in central and northern Sudan. The other Provinces reported small outbreaks, chiefly in trade cattle, totalling 72 and involving 21,785 head. Of the 30,040 cattle vaccinated 14,312 were trade cattle done to ensure freedom from disease during transit to external markets.

Foot-and-Mouth Disease.

All cattle registered for export were artificially infected with lymph in the early rains. No case of foot-and-mouth disease has been seen in the quarantines since this procedure was adopted.

An outbreak in a village herd on the Gezira was fortunately prevented from spreading to the working bulls of the Sudan Plantations Syndicate by the imposition of rigid quarantine restrictions.

Anthrax.

No positive case was reported.

Trypanosomiasis.

Isolated cases of cattle having become infected in Fung district proved, as usual, to be due to Arab owners not moving North to their wet-weather quarters before the onset of heavy rains. They know the danger of delaying their movement North, but the crop of luscious green grass which follows the early rains tempts them to stay too long.

M a n g e.

Psoroptic mange in cattle, owing to its benign nature, is not a serious problem in native herds in this country, but if not kept under control in working bulls on our irrigated areas it may cause considerable loss of efficiency. The Senior Veterinary Inspector, Blue Nile Province, stresses this in his Annual Report and asks for the co-operation of all interested parties to ensure that full protective measures are always taken whenever the disease is observed.

Liver Fluke.

A high percentage of cattle slaughtered at Malakal was found to be suffering from Liver Fluke.

H o v e n.

Over eighty cases were reported in Sudan Plantations Syndicate and Kassala Cotton Company's bulls, and were said to be due to animals which had been on short rations prior to the breaks of the rains ravenously eating of the lush grass which appeared after the first rainfall.

2. DISEASES OF CAMELS.Trypanosomiasis.

Sales of Naganol to Arab camel owners reached the large total of 13,440 compared with last year's record of 10,813.

Exceptional rains in camel breeding areas of Kordofan led to widespread infection and increased demands for Naganol. Approximately 5,900 doses were administered on payment in that Province. Infection was heavy, too, in Blue Nile Province and White Nile Sub-Province where 3,171 and 1,201 privately-owned camels respectively were treated.

All stockmen stationed in districts where there are demands for Naganol are being trained in the technique of Naganol administration and arrangements are being made for the drug to be on sale in their districts. This will enable owners to obtain early treatment for their animals, and should obviate much of the loss in condition that camels rapidly suffer when treatment is delayed owing to local inoculators not being available, and mean to an owner the difference between having to lay off his camel until he picks up condition in the following rains or having a saleable or workable animal soon after treatment.

The Lahawin and Shukria, in the past amongst our best customers, brought in few camels for treatment, and reported that fly was not bad in their areas.

The Veterinary Inspector, Kassala Province, states that many of the Eastern Arab Corps camels became re-infected during the dry season of the year when no biting flies were to be found on the grazing grounds. He is of opinion that some other vector than Serut fly is responsible for carrying the disease. Research to discover whether or not this is so would be costly and under present conditions not worth while instituting.

M a n g e.

Cases of mange were observed in all northern Provinces. The incidence however was everywhere light, particularly in native herds. A dressing having an oily base prepared by this Service has always been popular when free treatment has been given at Veterinary Hospitals. This year for the first time Arabs made purchases of this dressing for use in their herds, which goes to show that these particular people not only appreciate its value but are also sufficiently well off not to go to the trouble of making the special tar, prepared from melon or heglig seeds, which is commonly and successfully used as a mange dressing by Arab camel owners all over the Sudan.

Strongolysis.

Haemonchus longistipes is commonly found in the stomach of the camels in this country and does not appear to have a very harmful effect on animals in good condition, but in cases of debility, from disease, under-feeding or overworking, the worm rapidly increases in numbers and may, unless medicinal treatment and good feeding is adopted, cause death. In no case observed could debility or unthriftiness in a camel be directly attributed to worm infestation only. There was always a history of the primary condition being either due to some form of poor animal management or disease other than worms. All native-owned herds are driven at least once annually to salt licks where they are heavily drenched with a solution of the lick. Provincial authorities when re-arranging the distribution of grazing areas are liable to lose sight of the fact that it is essential for camels to have access at certain times of the year to districts where there are salt licks.

3. DISEASES OF EQUINES.

Horse Sickness.

Following the successful results of prophylactic treatment during the past three years, vaccination has now become general in the Gezira area of the Blue Nile Province. Of the three hundred and nineteen horses vaccinated in that Province this year only four succumbed to Horse ~~Sickness~~ Sickness.

Vaccination has been extended to Police mules in the Province and as a result it is now found possible to post mounted police permanently to many southerly posts from which it had previously been found necessary to withdraw them during the rains.

Cases reported from the horse breeding areas of Kordofan and Darfur were fortunately few considering the abnormally heavy rains experienced in those districts.

Epizootic Lymphangitis.

The incidence of this disease in the horse breeding areas was light, as has been the case for some years. With the exception of five cases which occurred in the Sudan Horse in the early months of the year only isolated cases in Government animals came under notice.

A decline in the number of cases occurring in Fung district from twenty in 1937 to five this year is attributed by the Senior Veterinary Inspector to constant supervision of all animals to ensure that wounds and bites, through which infection might occur, are kept covered with a protective dressing of an oily or tarry nature.

Strangles.

Strangles of a mild form has been noted annually as occurring in the Kordofan and Darfur horse breeding areas, but, beyond arranging for the quarantine of remounts to prevent its spread to Sudan Defence Force Units, little notice has been taken of the disease. This year however in Southern Darfur it took a more acute form and casualties were reported as having occurred, including one Government tribal stallion.

4. DISEASES OF CANINES.

R a b i e s.

No case was observed in the Upper Nile Province; otherwise all Provinces remained infected.

The Administrative Authorities continue to wage a campaign against stray and uncared-for dogs in the more populous areas, and as a result of this policy there has been a decrease in the number of positive cases coming from urban districts. It is, however, still difficult to obtain information as to how prevalent the disease is in remote rural districts. Large numbers of dogs are kept by cattle and sheep owning tribes

for night protection of their herds and flocks from wild animals, and, although occasional rumours come through of cases occurring amongst these dogs, investigation is rarely fruitful, since owners always fear repercussions in the shape of wholesale slaughterings of the guardians of their animals.

All Veterinary Stockmen when on tour in their districts carry out poisoning of wild carnivora with the co-operation of local Native Authorities.

Of the 123 specimens from suspected cases of rabies submitted to the Stack Memorial Research Laboratory for diagnosis, thirty-four proved to be from positive cases; dogs 26, donkeys 6, sheep 1 and wolf 1.

The following table shows the seasonal and topographical distribution of the cases :-

Province	:Jan:	Feb:	Mar:	Apr:	May:	Jun:	Jul:	Aug:	Sep:	Oct:	Nov:	Dec:	Total
Northern	: 1	: -	: -	: -	: -	: -	: -	: -	: -	: -	: -	: -	: 1
Equatoria	: -	: -	: -	: -	: -	: -	: -	: -	: 1	: -	: -	: -	: 1
Blue Nile	: -	: 2	: 1	: -	: -	: -	: 3	: -	: 1	: 1	: 1	: 1	: 10
Khartoum	: 1	: -	: 1	: -	: 1	: -	: -	: -	: -	: 1	: 1	: -	: 5
Darfur	: -	: 1	: -	: 1	: 1	: -	: -	: 1	: -	: -	: -	: -	: 4
Kassala	: 2	: 1	: -	: 1	: 1	: 1	: 1	: 1	: -	: -	: -	: -	: 8
Kordofan	: -	: -	: -	: 2	: 1	: -	: -	: 1	: 1	: -	: -	: -	: 5
Total	: 4	: 4	: 2	: 4	: 4	: 1	: 4	: 3	: 3	: 2	: 2	: 1	: 34

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SECTION II.

TRADE IN LIVESTOCK AND LIVESTOCK PRODUCTS

1. EXPORT AND IMPORT TRADE.

Cattle and Sheep

This year shows a further decline in the number and value per head of cattle exported to Egyptian markets. Except in years of exceptional agricultural prosperity the Egyptian fallaheen, usually of necessity small meat eaters themselves, appear able to supply most of their country's demands for fresh beef for six months of the year. It is only during the periods September to the end of December when Egyptian irrigated lands are being tilled and crops grown and there is consequently a shortage of bulk foodstuffs for animals and from January to March when Egyptian cattle are fattening on the resultant green crops that there is a steady demand for our cattle.

Many of the poorer European classes living in Egypt who formerly bought Sudan beef are now buying reasonably priced chilled or frozen meat and so another market is gradually being closed to us.

Beyond selling a few thousand extra cattle in years when prices of cotton and other agricultural products in Egypt boom, there appears small prospects of increasing our exports.

For the first time for many years the cattle trade with Egypt has proceeded without any interruptions from foot-and-mouth disease; a tribute to the successful manner in which artificial infection, arranged for by the Senior Research Officer, was carried out by his staff on all export cattle in the early rains, at the export entraining centre of El Obeid.

It was unfortunate that poor demands from Egypt coincided with exceptionally good conditions for stock in the Sudan. It would have been possible this year to export at least 20,000 fat western cattle from El Obeid alone, where grass has never been more abundant. It is usually grazed bare by December, but this year it was good at the end of the year, and those cattle still awaiting export were in prime condition.

The local price of sheep of export standard, coming from the flocks found in the northern districts of Darfur, Kassala and Kordofan Provinces has remained at about one pound Egyptian per head, a level at which Sudan sheep can only be profitably marketed in Egypt when conditions are abnormally prosperous.

There is every indication that sheep are on the increase throughout the Northern Sudan, but economic pressure still weighs so lightly on their Arab owners that they feel no urge to sell. The number marketed is therefore not sufficient to bring prices down to a level at which sheep can be extensively purchased in Egypt.

Cattle and sheep owning Arabs cannot be expected to put into effect our advice on curtailing the size of their herds and flocks as a means of preventing overstocking. Their reply to propaganda calling for bigger sales of stock is :- "Why should we sell more animals than will produce sufficient money for our immediate wants ? If we do, what are we going to do with the money that is over, except buy more stock ?" Until some simple form of commercial banking is introduced and the people are educated up to using it this question appears unanswerable.

A. Numbers and values of cattle and sheep exported during the last four years.

Year	Cattle	Sheep	Value at Port of export
1935	14,596	21,568	£E.84,765
1936	10,471	11,110	56,517
1937	8,985	5,417	49,729
1938	7,256	1,840	35,396

B. Numbers of cattle imported during the last four years.

Year	French Equatorial Africa	Eritrea	Abyssinia	Total
1935	5,764	-	1,662	7,426
1936	1,754	-	1,181	2,935
1937	1,754	-	171	1,925
1938	3,024	-	1	3,025

C. Origin of cattle exported during the last three years.

Province	1936	1937	1938
Kordofan and Darfur.....	6,088	6,118	5,191
White Nile.....	1,721	1,044	699
Upper Nile and Equatoria	338	-	-
Khartoum.....	198	202	132
Blue Nile.....	347	-	-
Northern	1,400	1,945	1,240
Kassala.....	13	-	-

D. Average market prices and total number of cattle sold
for export in El Obeid market during the last four years

Year	Number of cattle sold	Average prices
1935	6,759	SE. 2.087
1936	7,002	2.333
1937	7,651	2.365
1938	6,542	2.201

Camels.

In the early months of the year demands from Egypt for camels of both slaughtering and transport types, although not quite as heavy as those of last year, were steady. Approximately 11,180 head were sold by the end of April when, owing to an outbreak of foot-and-mouth disease in Upper Egypt, restrictions were imposed on the movement of Sudan camels in Egypt which necessitated the closing down of the trade. These restrictions were not removed until late in October. From then until the end of the year sales totalled 8,015, the aggregate for the year being 19,195.

The decline in sales, of approximately 8,000 head compared with the year 1937 was almost entirely due to the trade being stopped for over five months. Prices realised on the Egyptian markets varied from £E.3 to £E.13.

Reports show that the condition of the animals was good on arrival in Egypt and that they were remarkably free of disease.

Hides and Skins.

General

The steady increase in demands for hides and skins from abroad, and the resultant rise in prices registered in 1936 and 1937, were followed, as a result of the depressed state of foreign markets, by a falling off both in demand and prices at the beginning of 1938, which continued throughout the year. As a matter of course the flow to Sudan marketing centres decreased; low prices not justifying transport from remote places, but, so far as quality is concerned, the producer has not been entirely discouraged by the change from boom to slump conditions, since the percentage of those brought to Khartoum and Omdurman markets for sale which showed signs of having been prepared by the suspension method increased.

The general campaign of propaganda mentioned in previous reports has been continued by the Veterinary Service both in slaughterhouses and pastoral areas. Leaflets in English and Arabic explaining the essentials of airdrying, the technique of short trimming, suspension on frames and the superiority of folding once along the back, have been distributed to those who could best diffuse knowledge

among the people. In February well-prepared hides were on view at a veterinary booth in charge of an Animal Husbandry student at Shendi Agricultural Show who gave talks on improved methods of preparation. In December, the Senior Veterinary Inspector, Blue Nile Province and an Animal Husbandry Officer took part in Agricultural Shows held at Wad Medani and Mieliq. Demonstrations and talks were given to spectators at the shows on flaying, curing and marketing of hides.

Animal Husbandry Officers frequently inspect hides at Khartoum and Omdurman warehouses and abattoirs and also those arriving by steamer from the south, with a view to reporting on apparent defects and suggesting how improvements can be best carried out. Extracts from their reports are forwarded to Governors of Provinces from which the hides come, who on turn pass on extracts to District Commissioners from whose districts the particular parcels of hides mentioned originate. Many District Commissioners are doing excellent work in teaching their people improved methods of preparing hides and it is largely to their efforts that we are indebted for the gradual improvement that is taking place in air-dried hides coming from remote districts.

The District Commissioner, Tonj, in whose district all hides are inspected by Chiefs Courts before export, last year asked to be supplied with some simple means of marking hides emanating from his district. It was pointed out that it might be as well to give every Court a distinctive mark so that the hides of each area could be easily traced and reported on. This was agreed to and each Court has been given a number and supplied with a one-inch branding iron of the allotted number. If successful this scheme will be extended to other districts.

This has proved a bad year for the sheepskin trade and there are no visible signs of a recovery from the slump conditions which followed a sudden falling off in demands from the United States of America during the latter half of 1937.

Since our sheepskins are used for the making of leather goods largely destined for the luxury trade, a turn of the tide cannot be expected until the far more prosperous conditions prevail in America.

Prices of goatskins have slumped in sympathy with the sheepskins market.

Details of export are as follows :-

H i d e s.

Only 1,321 tons, valued at £E.59,546, were exported as compared with 1,462 $\frac{1}{2}$ tons worth £E.69,014 and 1,828 $\frac{1}{3}$ tons of a value of £E.116,667 in 1936 and 1937 respectively; a falling off of 27% in quantity and 49% in value as compared with 1937.

Egypt and Syria, taking 762 tons and 256 tons respectively, remained our best customers.

S k i n s.

Compared with 1937, exports of sheepskins have fallen from 1,048 metric tons of a value of £E.109,994 to 790 metric tons of a value of £E.38,281, and goatskins from 157 metric tons of a value of £E.17,614 to 104 $\frac{1}{2}$ metric tons of a value of £E.7,001.

S a m n (Clarified Butter)

Although the export price of clarified butter remained about the same as last year exports show a welcome increase of over 46 metric tons of a value of £E.2,258; a falling off in demands from Eritrea being more than offset by increased sales to Egypt, Arabia, British India and Abyssinia.

From the following table it will be seen that Egypt took nearly three-quarters of the total exports :-

Countries exported to		Kilos	£.E.
Egypt	.....	433,949	23,948
Eritrea	.....	66,724	3,644
Arabia	.....	40,950	2,307
Cyprus	.....	109	7
British India	.....	31,161	1,808
Abyssinia	.....	11,391	969
Belgian Congo	.....	6,791	576
		591,075	33,259

Four experimental creameries, at which clarified butter was made by the direct method, were operated by private enterprise during the rainy season. The separators and other equipment used at three of these creameries were loaned by the Veterinary Service.

One creamery operated by a merchant at Nyala produced 161 tins (4 gallon capacity) of excellent clarified butter.

The Veterinary Inspector, Kordofan, reports as follows on the other three creameries which were run in his Province :--

"Samm preparation by the direct method was
 "carried out experimentally by private
 "enterprise, under the auspices of the
 "Veterinary Service, at Abbasia and Muglad.
 "At the former place a merchant operated
 "the plant, and Babu Niur, Nazir of the
 "Humr Tribe, at the latter. The plant in
 "both the above cases was issued on loan
 "from the Veterinary Service and staff was
 "detailed to give the necessary technical
 "advice. At Abbasia the experiment was
 "by no means an unqualified success. The
 "cattle owners in the area are interested
 "in the cotton cultivation and cheap milk
 "is not available. Also the samm produced
 "was not of first quality owing to the
 "carelessness in carrying out the various
 "processes.

"Muglad samm was reported on as being of
 "the very highest quality. The Nazir, Babu
 "Nimr, said that he was going to continue
 "his attempt at samm production although
 "the profits were not concomitant with the
 "trouble involved.

"A third creamery, privately owned by
 "Sheikh Khalil Akasha, was operated in
 "El Obeid and later at Nawa. Advice and
 "instruction were given to his staff.

"The samm produced at El Obeid and Nawa
 "was not sold by arrangement with the
 "Veterinary Service as in the case of the
 "Abbasia and Muglad consignments. Sheikh
 "Khalil Akasha reports that the undertaking
 "was by no means profitable. That part of
 "the work carried out at El Obeid entailed
 "a high purchase price for milk. At Nawa

"Sheikh Khalil Akasha admits that perhaps
 "the honesty of his staff was in question.
 "Butter fat was often as low as $3\frac{1}{2}\%$! The
 "skim milk was utilised for cheese making,
 "but it was found that the pure separated
 "milk product was not saleable so the
 "process was continued by adding 50% sweet
 "milk. Some gross figures given by the
 "merchant were as follows :-

"Total expenditure £E.140. Samn produced
 "48 kantars (some of which has not yet been
 "sold). Price for proportion sold £E.3.200%
 "per kantar."

Complaints of meagre profits were found to
 be due to operators purchasing milk at a price in
 excess of the maximum recommended in a "Note on
 clarified butter production by the direct method"
 issued by this Service.

Sheep Casings.

Demands from Egypt, our best customer, were
 light. Exports this year totalled $4\frac{1}{4}$ metric tons
 compared with $9\frac{3}{4}$ tons in 1937.

II. INTERNAL TRADE.

Meat Supplies.

The numbers of animals slaughtered for
 food in ten of the larger towns during 1938, and
 the totals for 1938 and the three previous years
 are given below :-

Town	:Camels:	Cattle :	Sheep :	Goats
Khartoum	: 6 :	3,099 :	29,188:	34
Khartoum North	: 6 :	756 :	9,184:	77
Omdurman	: 118 :	4,957 :	38,369:	1,906
Carried forward:	130 :	8,812 :	76,741:	2,017

Town	Camels	Cattle	Sheep	Goats
Brought forward	130	8,812	76,741	2,017
Wad Medani	981	2,008	20,223	333
El Obeid.....	437	4,273	13,071	422
Atbara.....	43	1,197	11,983	-
Kassala.....	386	512	14,314	1,244
Gedaref.....	608	840	4,710	261
Port Sudan.....	266	1,285	23,349	7,360
Wadi Halfa.....	3	295	3,975	20
Total.....	2,854	19,222	168,366	11,657
=====				
Total for 1935	1,478	21,548	153,766	7,893
" " 1936	1,597	22,263	171,333	7,932
" " 1937	2,212	20,240	185,822	7,670

The slaughterings of sheep in these towns may be taken as an index of the prosperity of the country. Mutton is the best fresh meat obtainable, but as it is the most expensive the poorer classes can only afford to eat it when times are good. Slaughterings of sheep during the past four years point to 1937 as being the peak year of the present trade cycle.

Except for the usual seasonal shortage at the end of the dry weather period, supplies of cattle and sheep to the bigger towns were steady, and following this year's rains the condition of slaughter cattle and sheep was exceptionally good up to the end of the year.

SECTION III.IMPROVEMENT OF LIVESTOCKCATTLE.

Cattle of the Sudan north of the tenth parallel of latitude may be generally described as of the shorthorn zebu type, characterised by the presence of a hump and a pronounced dewlap.

Many variations in the characteristics of the type are to be found in different areas, or even in different herds of the same area, in regard to size, colour, horns, hump and dewlap. These local variations have been brought about by inbreeding, adaption to environment; which, where feeding and climatic conditions are above the average have caused an up-grading and where they are the reverse a down-grading; and in some instances by the introduction of outside blood, such as that of the long-horned type from the Southern Sudan.

The conditions under which stock lives are rarely easy throughout a normal year, and the occasional famine year too has to be faced. In the true pastoral areas grass is plentiful and surface water available from July to the end of December, but from then onwards to the break of the rains water and grazing conditions (which vary not only from year to year but also in different localities) become more severe. The easiest conditions probably obtain in the White Nile Sub-Province where cattle rarely go more than two days without watering, and the hardest in North Darfur where at the driest period of a dry year waterings may only take place every fourth or fifth day.

Under these conditions local breeds have been evolved, by natural selection dictated by environment, which are best suited to prevailing conditions, and any attempt at improvement by the introduction of better sires would lead to disastrous results unless one could guarantee to introduce at the same time improved methods of animal husbandry (conservation of forage, prevention of disease, and overstocking in particular). As the local breeds have in many instances been established by a process of "the survival of the fittest" any alteration in

constitution brought about by the introduction of new blood would lead to a lowering of resistance to both local diseases and hardships, which would render the breeds open to heavy losses under certain conditions.

Amongst nomad cattle-owning tribes we are for the time being limiting our stock improvement efforts to propaganda and demonstrations on the benefits of careful selection of stud bulls and unsexing of scrub bulls by humane methods.

In agricultural areas Province Veterinary Inspectors have been called upon to interest themselves in the village herd, which is an essential part of the economic life of the peoples of the increasing number of agricultural villages to be found on the banks of the Niles. Much remains to be done to bring home to these people the benefits of following certain very elementary principles of animal husbandry, but with the help of the enlightened tribal administrations, and the co-operation of the educational authorities, improved methods of stock keeping are gradually being adopted.

SHEEP.

White Nile Sub-Province, listed to contain over four hundred thousand mature sheep, is considered to carry more head of sheep per square mile than any other pastoral area in the Sudan.

In the Northern section the sheep are practically all of the leggy long-haired type with fat tails reaching almost to the ground. They weigh up to 130 lbs. and are very similar to those found in Northern Kordofan and the Butana District of Kassala Province. Their owners are good flockmasters and, besides showing a certain amount of care in the selection of their breeding rams, also take steps to ensure that lambing is restricted to once a year. Owing to having ample grazing on sandy soil available during the rains they are not greatly affected by disease. They command a good price both for internal consumption and export.

The Central area of the Sub-Province contains a very mixed collection of sheep mostly evolved from a cross of the leggy Northern type with the short-legged Southern breed. The predominating colour is brown with white markings.

They weigh up to 80 lbs. live-weight and have shorter tails than the Northern breed. Lambing usually occurs once a year, but where river grazing is exceptionally good two crops of lambs may be produced. This intermediate type seems well suited to a region where conditions although not favourable to supporting the well bred Northern sheep are suitable for something a little better than the Southern breed.

In the South of the Sub-Province are found the Southern type of sheep. They are small, white in colour with black markings and tails which may reach the hock; they only weigh up to 40 lbs. This breed, which is now well established, was formed by the introduction of Dinka and Shilluk sheep and an occasional ram from the Central area. Lambing in most instances takes place twice a year, once when they are on the sandy ridges in their wet weather quarters and next when they move south and are feeding on the lush grazing which springs up as the river falls.

The Northern, Central and Southern flocks are undoubtedly increasing at an enormous rate, particularly the latter, which lamb twice a year. The time is not far distant when drastic steps will have to be taken to ensure that overstocking does not lead to a deterioration in the quality of existing stock.

In the White Nile Sub-Province the increase in the size of flocks has been most pronounced of late following a sequence of good agricultural years in which the Arabs have been able to obtain nearly all the money they need for taxes and small immediate wants from the sale of agricultural products without having to sell all their surplus male sheep, much less a single female one.

It may be found possible to prevent overstocking in cattle by a beneficial limitation of prophylactics, combined with compulsory marketing of surplus male stocks, but in the case of sheep, which in the Northern Sudan suffer from no major disease, there would appear to be no solution outside legislation permitting, when necessary, the drafting of laws giving local authorities, under the guidance of this Service, powers to cull flocks by forcing owners in overstocked areas to sell for slaughter not only all surplus males but also whatever percentage of females is considered necessary to prevent overstocking.

HORSES.

The policy enunciated in last year's Report is being put into operation. Its general principle is completely to exclude English sires and to infuse a small proportion of Arab blood as widely as possible over indigenous breeding areas. This procedure is to be effected by maintaining a reduced number of Government-owned Arab sires (by only partial replacement of casualties) and enrolling as "tribal stallions" the best of the locally-bred colts which contain a greater or lesser proportion of Arab blood; these stallions are to be maintained by the local tribesmen in return for a small cash allowance. Small bonuses are also to be paid to the owners of a limited number of mares selected to stand to Government-owned sires, the bonuses being renewed annually provided the mares are produced in good condition, and either in-foal or with foal at foot, at the appropriate horse shows. At the end of the year 95 mares were receiving such subsidies. In order to maintain interest, small gratuities are also given to owners whose mares and foals are in good condition and appear to have received more than the minimum of feeding and general care. These shows are only held in Kordofan and Darfur, which are the only two Provinces in which horse breeding is conducted on a significant scale.

The operation of the scheme in each Province will be recorded separately :-

Kordofan.

Only two Arab stallions are now maintained; these served 93 and 82 mares respectively during the year.

Two horse shows were held, namely at Muglad on the 5th December and at Sinüt on the 12th December. About 1,200 horses appeared at the former, of which 29 were purchased for Government service, and 600 at the latter, of which 22 were bought. Two tribal stallions were also selected to replace two imported Arabs which had died during the year, and a third was transferred from Darfur bringing the total up to six.

Darfur.

At the end of the year this Province, which is the more important horse-breeding unit of the two, possessed seven Arab and 31 tribal stallions. The projected establishment is six of the former and 45 of the latter. The Arabs served 284 mares during the year.

Four horse shows and one tribal gathering were held, the following being brief notes on each :-

1. "Id El Ghanam" At this show, which was held in January for the Beni Helba, T'sisha and Gimr, over 2,000 horses paraded. Of these, 49 colts were purchased as remounts and two selected as tribal stallions; 15 mares were selected to receive a bonus.

2. "Nyala" This show was also held in January; over 3,000 horses paraded and 41 were purchased, four being enrolled as tribal stallions. Twenty-two mares were selected for subsidy.

3. "Sibdu" The Rizeigat, Maalia and some Birgid attend this show. A few over 3,000 horses were shown, of which 41 remounts and one tribal stallion were selected. Eighteen mares were selected for subsidy.

4. "Abu Salaa" Attended by Habbania, Fellata, Messalat and Beigo. A few over 3,000 horses were shown. Seven tribal stallions and 42 remounts were selected, and 40 mares subsidised.

Kuttum Gathering : This gathering of the tribes of northern Darfur was attended by His Excellency The Governor-General. Some 7,000 tribesmen were present, mostly mounted on camels. Few horses of any quality are bred in this district, but ten remounts fit for Government service were purchased.

Approximately half the remounts and tribal stallions selected at these shows were the progeny of imported horses, but it is hoped that when the tribal stallions have had time to sire some stock most of the purchases - of remounts at any rate - will have a larger proportion of native blood.

Although the depredations of locusts had in some instances led to serious shortage of grain and grass, all potentially saleable horses were shown in first-class condition. It is therefore evident that the horse breeders of Darfur take a serious interest in their stock, or at least they regard sales as so useful a source of income that they give especial attention to the horses they hope to sell. That 95 mares, out of a projected cadre of 200, were fit for subsidy, is further proof of their interest, as is the fact that many other mares qualified for a gratuity.

In the early part of the year the Royal Agricultural Society of Egypt generously presented the Sudan Government with the pedigree Arab stallion "Hadab". This welcome addition to the breeding section is now standing at Khartoum.

SECTION IV.EDUCATION.

The school of Veterinary Science, sited in close proximity to the Khartoum Veterinary Hospital and the Veterinary Research Laboratory, was opened at the beginning of the year.

Three students, who had completed their first year's study at the Kitchener School of Medicine (where chemistry, physics and biology are studied in the same classes with medical students) were enrolled for a further three years' course in purely veterinary subjects. Although this is the first year during which the School of Veterinary Science has operated, the course of instruction has constituted the second session of a four years' professional course.

The course of study is designed not only with the marked bias towards tropical medicine and hygiene that is desirable for those who will spend their professional lives in tropical Africa, but, also, in virtue of the infinitesimal opportunities that exist for private practice, incorporates a study of departmental administrative routine and local legislation, a thorough knowledge of which is essential to those destined for official careers. This particularly local and official orientation will become progressively more evident in the later years of study.

During the present year instruction was given in anatomy, physiology, histology and animal husbandry. The progress of the students was checked by interim test examinations, and all succeeded in passing the professional examination at the end of the year.

It is necessary to add that in their non-working hours the veterinary students are accommodated in the hostel of the Kitchener School of Medicine, where they share the social and athletic activities of the medical students. Acknowledgments are due to the Registrar of the Kitchener School for his co-operation and interest.

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SECTION V.

MISCELLANEOUS.

Grazing and Watering.

With our conditions varying from desert in the North to swamp in the South it is exceptional as was the case this year to receive from all Provinces reports of a generous rainfall followed by good grazing conditions. Only in Dar Shankab area of the White Nile Sub-Province was grazing said to be poor owing to deficient rainfall followed by locust visitations. Fortunately the Tribal Administration was able to find temporary accommodation for many of the flocks and herds of this heavily stocked area on other tribal grazing lands within the Administration.

In Khartoum 15.2 inches of rain were registered compared with 4.7 inches in 1937 and for the first time for many years there was every prospect of the whole Province enjoying good grain and grass crops. The outlook for the ever increasing flocks of goats which furnish the poorer classes of Khartoum, Khartoum North and Omdurman with a meagre supply of milk seemed bright but, as has occurred in the past, rain in "plenty" coincided with locusts in "plenty". The passage of a few swarms of locusts through Khartoum Province turned the knee-high grazing into just above an average year's crop and much of the young grain received a set-back from which it never recovered.

Reports of varying degrees of damage done to crops by locusts have come in from all over the Sudan, losses being particularly heavy in Fung District, where, however, bumper crops of simsim will go far to alleviate the grain shortage by providing the people with money for the purchase of food.

Foodstuffs

The following extract from a report forwarded by Veterinary Inspector, Kordofan, is of interest :-

" A remarkable result of increased cotton
 " growing and the installation of ginneries
 " at various centres is the feeding of
 " cotton seed ad li: to native cattle.
 " The waste cotton seed is removed to
 " some spot away from the ginnery and
 " there native cattle eat to repletion."

In a recent Bulletin issued by the Department of Agriculture, U.S.A., the following remarks are made on the feeding of cotton seed :-

" Untreated cotton seed is stated to
 " contain a substance called gossypol,
 " which is said to be toxic to animals.
 " The substance can be made inactive by
 " cooking the seed after the addition
 " of water."

Similar warnings have always been sounded in many other publications dealing with the use of cotton seed as a foodstuff for animals, and this Service, too, has issued such warnings to those interested in its use in the Sudan.

In April, 1938, some thousands of cattle were seen at Um Berembeita in the Nuba Mountains, which, much to the astonishment of the writer, were found to be living on cotton seed alone. All appeared markedly healthy and in excellent condition. Owners stated that their cattle suffered no ill affects when changed over from grass grazing to a diet consisting entirely of cotton seed.

Beyond using it as a bait to attract cultivators to cotton growing areas by allowing them to feed their stock on it indiscriminately, and by so doing encouraging in many cases increases of cattle in already overstocked areas, this valuable food is, under existing conditions, of limited value. Uses other than the present wasteful one will be explored and implemented as circumstances permit.

Veterinary Hospitals.

Khartoum Civil Veterinary Hospital and Forge :-

Out-patients.....	10,552
In-patients	6,185
Pairs of shoes fitted.	2,299
Pairs of shoes removed	107
Rasping of feet, etc..	635

During the year permission was obtained to take over part of a sandy lane, which runs northwards from the Veterinary Hospital and is shaded by trees growing in the Gordon College grounds, for use as sick lines for the poor man's

animal. Here animals requiring rest or veterinary treatment are stabled and cared for free of charge, owners having to provide forage only. The local branch of the Royal Society for the Prevention of Cruelty to Animals has kindly provided funds for paying an attendant and meeting expenses incurred in making the lines.

Courses for Sudan Defence Force Farriers were held at the Forge.

Wad Medani Civil Veterinary Hospital :-

Out-patients	11,047
In-patients	870

All Police in Blue Nile Province now attend at the Veterinary Hospital for a fortnight's course in stable management, ordinary dressing and first aid work.

Sudan Defence Force Animals.

The establishment of animals at the end of 1938 was :-

1,307 horses, 309 mules, 248 camels, 54 bulls and 12 donkeys.

The general condition of animals in the Sudan Defence Force may be said to have been above the average, the only outbreaks of disease worth noting being three cases of epizootic lymphangitis in the Sudan Horse in the early months of the year and the usual crop of trypanosomiasis cases in the camels of the Eastern Arab Corps, during and after the rains, to which I have referred in my remarks on trypanosomiasis in camels.

Acknowledgments

The vast area that a Veterinary Inspector has to supervise, on the average approximately one hundred thousand square miles, makes him largely dependent on the co-operation and assistance of members of provincial staffs and those of all other Departments and Services for the success of his work. This year, as in the past, it gives me great pleasure to note my appreciation of the kindness and help given by all who have been asked to assist in furthering our veterinary activities.

(Signed) H.B. Williams

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DIRECTOR, SUDAN VETERINARY SERVICE

ANNUAL REPORT
OF THE SENIOR RESEARCH OFFICER,
SUDAN VETERINARY SERVICE
FOR THE YEAR ENDING 31ST DECEMBER, 1938.

A. STAFF AND GENERAL

In general the activities of the Research Section have differed little from those of the immediately preceding few years. There have been no changes in the constitution or distribution of the staff, but with the increasing amount of time devoted by the Senior Research Officer (who is also Assistant Director) to administrative work, and the full preoccupation of the remaining staff with routine duties, no deliberate research has been undertaken. A few small ad hoc problems have, however, received attention.

B. ROUTINE WORK

The usual procedure has continued of preparing cattle plague serum at the Malakal Laboratory and carrying out the remaining work at Khartoum. The following are reports on the individual items :-

I. CATTLE PLAGUE SERUM

Although, as in the immediately preceding years, an attempt was made to prepare 125,000 full doses (6,250 litres) of serum, the amount finally produced was only 102,240 doses (5,112 litres). When it was first decided, in 1936, to aim at a total of 125,000, it was realised that this quantity was a maximum that could only be attained under ideal conditions of grazing and in the absence of all vitiating factors such as difficulty in obtaining enough suitable cattle, sickness of staff, labour strikes, etc. That the hoped-for total has never yet been reached - although it attained 124,000 on one occasion - is the result of some limiting factor always having arisen to interfere with operations.

The commonest limiting factor has usually been associated with the supply of cattle; either it has been impossible to obtain a sufficient number, or those obtained have not been entirely suitable. It has always been hoped that the Upper Nile Province would supply all the cattle required, but, although the Province is quite

heavily stocked, the owners cannot be induced to part with many of their beasts. A certain number are supplied by the Province staff, who have obtained them in the form of tribute or fines, but it is necessary to purchase the great majority for cash. Every assistance is given by the Province staff, who are anxious to encourage a money sense, but the natives are so little money-minded and their requirements of cash are so infinitesimal that the response is very poor. The result is that a good deal of time trouble and expense are entailed in arranging for supplies from outside sources. Out of a total of 1,618 cattle purchased for the current season's work 802 were of Upper Nile origin and 816 were from other Provinces.

To the general trouble and expense of obtaining cattle from outside sources may be added the fact that "foreign" cattle are not so suitable. The pagan cattle of the south are very docile and are therefore particularly suited to the process of serum making, which entails repeated handling at short intervals. Arab cattle, on the contrary, are usually very wild, and waste a good deal of time. Fortunately, however, more than half of the large cattle, from which the serum is actually drawn, were this year obtained from within the Province and the deficiency was made up with cattle of similar type from Equatoria.

An additional disadvantage in collecting batches of cattle from farther afield is the danger of introducing contagious disease. This year both foot-and-mouth disease and cattle plague were introduced by two consignments of cattle purchased at Kosti for use as virus producers, with results that need not be described. And finally many cattle from Arab areas, whence one particularly obtains small bulls for virus production, prove to be immune. As an indication of the effects of the two foregoing items it may be recorded that, of 909 small cattle used, only 484 were actually bled as virus producers.

During the present year the Governor has approved of a system of barter whereby cattle, instead of necessarily being purchased, may also be exchanged for some form of immunisation against cattle plague. The free administration of serum and vaccine at and near outbreaks of disease is being suspended and these prophylactics are only being issued to owners who are prepared to give cattle in exchange. The sale of cattle in normal times will also be a title to the issue of prophylactics when disease appears. In time the

natives may come to realise that it is better to sell their cattle and have free issues of serum and vaccine than merely to exchange cattle for treatment.

Grazing is another factor which influences the serum output. All cattle at the Malakal Veterinary Laboratory are entirely grass-fed, and no supplementary rations are provided. Serum is therefore produced in the Sudan at a very low cost. Adequate grazing areas have been allotted, but varying conditions of rain and river are responsible for wide fluctuations in the amount and quality of grass from season to season. This year, grazing became scanty rather early in the season and operations had to close down somewhat earlier than usual.

The anti-amaryl regulations that have been imposed in Malakal consequent on its development as a regular flying port have been a source of minor annoyance. The Veterinary Laboratory, although well clear of the town, is close not only to both the landing ground and the reach of river used by flying craft but also to Imperial Airways' rest house; it is consequently within the anti-amaryl area in which no men must be in the open between the hours of 5.30 p.m. and 6.30 a.m. On busy days preparations for work were normally commenced at about 4.30 a.m. and work continued until sunset, so that two valuable hours are now lost. In addition the landing reach of river is kept clear of all traffic on certain mornings for mail boats to land and take-off; consequently labourers living on the opposite bank to the laboratory arrive late. Nevertheless Malakal appears to be the only place in the country where serum can be prepared on the existing scale and at the present cost and the technique must adjust to prevailing conditions.

The health of the staff was, according to local standards, good. All the technical assistants suffered at one time or another from malaria, but as in most earlier years they conveniently contracted it one at a time.

Having recorded the difficulties encountered in maintaining the preparation of serum at the desired level, it is tragic to record that nearly the whole of the current season's output had to be destroyed. When freshly prepared it was found to be both potent and innocuous. Shortly after issue, however, complaints were received that it was causing the death of a high proportion of cattle injected

with it. The steps taken to cope with this situation are recorded in the section on research, but it may here be stated that the trouble was due to bacterial contamination that could not be removed, so that all remaining stocks had to be destroyed. It may, however, be added that although this season's stock could not be saved a new technique of preservation was evolved that should prevent a similar catastrophe in future.

Although it was anticipated that the country would for the greater part be able to maintain control of cattle plague with vaccine, it was thought necessary to prepare a small stock of serum in Khartoum in case special circumstances should arise in which vaccine would not be satisfactory. Accordingly a small stock of about 6,000 doses was prepared. Of these, as it happened, only about 2,000 were actually needed, and the remainder was kept for adding to the stock emanating from Malakal in 1939.

II. CATTLE PLAGUE VACCINE

The technique of preparing this product remains as before. The vaccine consists of emulsion of the lymphoidal tissues of cattle, bled to death at the height of the thermal phase of cattle plague, emulsified in a sixty per cent. aqueous solution of glycerine and adjusted so that a "standard" dose of 10 c.c. represents a tissue content of about one gramme per hundred kilogrammes live weight for the average adult beast of the country.

A large proportion of the tissue so used is recovered from virus-producers in the Malakal Laboratory, whence it is dispatched in cold storage to Khartoum after being roughly minced and treated with glycerine. Additional material is acquired from the Medical Service who hand over yearlings previously used for smallpox vaccine preparation.

With these two sources of supply, added to which would be a number of young cattle used for various purposes in the Khartoum Laboratory, it was hoped that a very large proportion, if not all, of the country's requirements of cattle plague vaccine might be made from the by-products of other processes. In spite of exceptional circumstances this hope has not fallen far short of realisation.

In the earlier part of the year, with the existence of stocks of serum prepared in 1937, demands were moderate, but in the later months, as the result of the serum catastrophe recorded in the preceding section, they became heavier because, in the absence of serum, vaccine was the only product available for the control of the disease. Owing to the necessity both for preparing emergency stocks of serum in Khartoum, and for doing one's best to obviate further losses on account of serum contamination at Malakal, supply could not always keep abreast of demand after existing stocks of vaccine became exhausted. Furthermore the worst stage has not yet been reached. The heaviest demands for cattle plague prophylactics invariably occur towards the ends of the dry season, and, as an adequate supply of serum will take some time to prepare, still heavier demands for vaccine must be anticipated in the near future.

The actual output during the year was 117,331 standard doses as against 103,090 last year. Given less preoccupation with other duties a good deal more could have been prepared. It is, however, probable that in this case funds would have been exhausted, since a fair number of additional cattle would have been required.

In any case it is probable that in future years more cattle will have to be specially purchased, since it appears that, with improving technique in the preparation of smallpox vaccine in the medical laboratories, the lymph producers give a higher yield, and in consequence fewer cattle will be forthcoming from that source.

III. CATTLE PLAGUE VIRUS

Virus continues to be issued on a small scale for use in the "serum-simultaneous" method of immunisation. This method is only practicable over a small range but is very suitable for the immunisation of cultivators' cattle in the Gezira area of the Blue Nile Province, where it is now an established procedure.

The only feature of technical interest is that relatively small quantities, of a few hundred doses at any one time, are required, and that these demands are liable to be made at almost any moment, as and when a large enough number of fresh cattle accumulate to be worth the trouble of immunising.

A type of virus that can be kept in stock for considerable periods is thus desirable. Glycerinised lymphoidal tissue virus, maintained in cold storage, has been found to be ideal, since it retains its virulence for several weeks and arrangements can be made to keep stocks in Khartoum which will be available for immediate issue, in any quantity that is likely to be required, without any greater expenditure than would normally be required for merely maintaining a stock strain.

IV. CONTAGIOUS BOVINE PLEURO-PNEUMONIA VACCINE

For the second year in succession demands for this product have been relatively low. Only 29,635 and 30,040 doses were issued in 1937 and 1938 respectively as compared with over 50,000 in the preceding few years. It appears that the disease is on the whole appreciably less prevalent than formerly, although there are still areas, especially in the west, in which infection obstinately persists.

V. CAMEL TRYPANOSOMIASIS CONTROL

Demands for diagnostic materials and for naganol have continued to increase, 14,748 doses of the latter having been issued as compared with 10,701 and 12,938 in the two preceding years. Most of the issues, namely 13,440 doses, were for the treatment on payment of privately owned camels.

No new information has been acquired. Both diagnosis and treatment continue to give almost complete satisfaction, but occasional complaints are made that camels are not cured by the single routine dose of five grammes. Some of the reputed relapses are undoubtedly reinfections, acquired in consequence of giving treatment too early in the year, since, in virtue of the very transient refractory period which follows treatment, reinfection in such circumstances is always a possibility. It has, however, already been proved by laboratory experiments that a small proportion of camels is extremely difficult to cure, even by large or repeated doses of the drug, and it is therefore certain that some of the reputed relapses really are such. A marginal profit is made from the treatment of privately owned camels, and, as the great majority of owners are obviously quite

satisfied, there is at present no justification either for attempting to keep records or for undertaking further studies. Most of the patients treated are grazing camels and few of these suffer much harm from a few weeks' delay in treatment. The best that can reasonably be done for them is therefore to advise owners to delay their demands for treatment, at any rate of non-working camels, until so late in the autumn that the chances of reinfection have become minimal. The owner of the exceptional beast which is difficult to cure will have to continue to put up with his bad luck and either pay for further treatment or dispose of his camel however he wishes.

VI. AFRICAN HORSE-SICKNESS (NIGMA)

Distribution of neuro-vaccine prepared in Kenya has continued and altogether 507 doses were issued as compared with 360 last year. Of these 389 were used for the immunisation of privately-owned horses, the remaining 118 being given to Government animals. Five vaccinated horses subsequently died of what appeared on clinical grounds to be horse-sickness, and samples of blood have been sent to Kenya for investigating the possibility of new types of virus being at issue.

Interesting information has been provided following the dispatch of similar samples last year. Three samples were sent, and reports were received that two of them probably contained a virus of a well known type for which provision is made in the vaccine. The third sample, however, did not contain horse-sickness virus although the animal from which it was collected had shown appearances that on clinical grounds fully justified this disease being diagnosed. The significance of this observation cannot as yet be assessed, but it is reported that the same phenomenon has occasionally been observed when studying reputed horse-sickness material in East Africa and it is being further studied. Meanwhile, however, no new virus type has yet been found in the Sudan and the use of the vaccine may be continued with the knowledge that there is no reason for believing that it is not quite as efficacious in this country as in those for which it is primarily prepared.

VII. FOOT-AND-MOUTH DISEASE VIRUS

So far as the grazing herds of the Sudan are concerned, foot-and-mouth disease is of little account; it certainly occurs in some districts, but cattle owners take little notice of it. It may cause occasional deaths among the younger and the weaker stock (in the latter instance being all for the good) during the dry season, but when grass is plentiful, and especially when it is green, the disease may go through a herd without appreciably setting the animals back in condition. When, however, the disease appears among cattle destined for export, as has happened during the past two or three seasons, quite serious loss ensues. The loss is not so much due to the death of merchants' cattle, since hardly a single beast dies, but to the expense incurred in feeding them during the delays that occur after they have left their original grazing grounds.

When infection has been known to exist in the vicinity of entraining centres, e.g. El Obeid and Kosti, attempts have hitherto been made to avoid delays by dispatching apparently recovered cattle only. In spite of various systems of selecting and marking the beasts it has nevertheless not proved possible to prevent the entry of the disease into the chain of export quarantine parks. Moreover, although there is no doubt of its highly contagious nature, it has been found to need a surprisingly long time to work its way through a lot of beasts running loose in a relatively small cattle yard. Short of duplicating the chain of quarantines, which would be extremely expensive, the only alternative appeared to be to ensure that nothing but recovered cattle were originally entrained by deliberately infecting or attempting to infect every "registered" beast some time before loading.

A strain of virus was therefore isolated at Kosti at the end of last season and the certainty of various routes of transmission studied in Khartoum. Briefly stated, the most rapid and certain - in fact the only certain - method of transmission in cattle was found to be by injection of virulent lymph into the tongue.

Foot-and-mouth disease virus is fortunately easy to maintain, and is of much high titre that large numbers of doses can be prepared at short notice. This season, accordingly, all merchants' cattle registered for export were injected into the tongue with foot-and-mouth disease virus at the time

of registration (in June), at the same time as they were vaccinated against cattle plague and contagious bovine pleuro-pneumonia. The great majority of the cattle became infected but apart from a transient falling off in the condition of some of them no ill effects followed.

The result has been that up to the end of the year no case of foot-and-mouth disease has been detected in any export beast.

While the results hitherto can be regarded as perfect, it is early to be sure that they will continue so. It is not yet known whether one or several immunological types of virus exist in the Sudan, and it is at least conceivable that more than one may come to light. The virus used in this year's infection campaign has been sent to the Veterinary Laboratory at Weybridge (England) with a view to determining its type, and if it is suspected that other types are at issue they will first be tested against the original local strain and then also sent to Great Britain for further study if they appear to be immunologically different.

VIII. EXAMINATION OF SPECIMENS

The number of pathological specimens submitted for examination from outside sources fell from 636 to 355. As usual few of these were of any special interest, most of the diagnoses being of well-known local conditions. Two items may, however, be especially noted :-

- (i) The continued appearance of cryptococcus infections in which lesions are limited to the conjunctiva and lachrymal region - four such being diagnosed.
- (ii) The identification of Aegyptianella pullorum in a turkey. Although it was in the Sudan that this parasite appears first to have been seen (by Balfour, 1911, who thought it to be a developmental phase of Spirochaeta gallinarum in fowls) it has never before been the writer's good fortune to see it, in spite of having over a period of 13 years in the country examined the blood of innumerable fowls, both infected and not infected with spirochaetes. A further interesting observation is that the infection occurred in a turkey and not in a common domestic fowl.

Miscellaneous less interesting diagnoses included :-

- Horses : Tryp. brucei, Babesia caballi, epizootic lymphangitis, microfilaria in blood, ringworm and various septic and helminthic infections.
- Mules : Epizootic lymphangitis, habronemic granuloma and various septic infections.
- Donkeys : Epizootic lymphangitis, ringworm, and helminthic infections.
- Cattle : Tryp. congolense, Theileria sp., miscellaneous septic and helminthic infections.
- Camels : Tryp. evansi
- Fowls : Spirochaeta gallinarum.

C. RESEARCH

Deliberate research has again remained entirely in abeyance, but a few minor items have received some attention, these being as follows :-

SERUM PRESERVATIVES

Hitherto cattle plague antiserum in the Sudan, which has it in common with all kinds of serum prepared on a large scale that it cannot be bacteriologically sterile, has been treated with carbolic acid in a concentration of five or six parts per thousand. Five parts per thousand is in most countries recognised as being sufficient to inhibit the multiplication of bacteria, but in the quite early days of serum preparation in this country it was found that this concentration was hardly adequate. The quantity added was therefore increased by twenty per cent., which was the limit to which it could be increased without either causing considerable precipitation or indulging in undue dilution.

The bacteria which multiplied at the lower dilution were not, in the usual sense of the word, pathogenic, and apparently caused no harm to cattle injected with the serum, but after some months'

storage the serum became cloudy and tended to thicken or even coagulate. The fact that this concentration of carbolic acid, that is so commonly used as to constitute almost an international standard, failed to inhibit bacterial growth was attributed to local conditions of storage; specially it was thought that the average conditions of temperature were probably nearer the optimum for bacterial multiplication than elsewhere. In any case, pending an opportunity for investigating the matter more fully, the effect of a little more carbolic acid was tried and found satisfactory within the limits of local practice. On lengthy storage, however, the serum still continued to become cloudy, and it was realised that the problem was not finally solved.

That it was by no means finally solved became only too certain this year, when the whole of the serum output of the Malakal laboratory became infected not merely with so-called "non-pathogenic" bacteria but with highly virulent organisms which rapidly killed a large proportion of the cattle injected with it. The nature of the contamination was not detected early in the season. On routine testing for potency the product was found to be both innocuous and highly protective, and it was not until the working season was nearly over, and nearly all the serum distributed, that reports of casualties began to arrive. By the time the danger was fully appreciated from the use of early issues of serum, tests of the later issues showed that they were equally badly contaminated.

Suspicion first centred round the carbolic acid, the possibility being considered that in consequence of pilferage and dilution an adequate quantity might not have been incorporated. The Government Chemist, however, found the remaining stock of carbolic acid to be unadulterated and the serum to contain its appropriate percentage.

Bacteriological examination showed the serum to contain large numbers both of haemolytic streptococci (a surprising discovery in consideration of its phenol content) and of a presumed non-pathogenic sporing bacillus of B. subtilis type. No material was sent to the laboratory from cattle which had died after receiving the serum; the symptoms recorded had been in keeping with those of acute septicaemia and streptococci were tacitly accepted as the cause.

The twofold problem was (a) to find some means of rendering the existing serum safe, and (b) to avoid a recurrence of the contamination.

It had to be remembered that the two phases of the problem did not necessarily overlap, since the bactericidal and bacteriostatic values of most disinfectants by no means coincide.

Attempts to salvage the existing serum were unsuccessful. The streptococci could be eliminated in twenty-four hours by adding acriflavine in a dilution of 1-50,000 and in forty-eight hours in a dilution of 1-100,000. When samples of streptococcus-free serum were tested in the Laboratory on sixteen young cattle at various dosages two insuperable obstacles were encountered. The first of these was that the supposedly non-pathogenic "B. subtilis" caused very large swellings to develop. These appeared within three or four days of the injection, becoming progressively larger and more painful for a period of about a week, and persisting for about a second week. In size and character they were almost comparable with the local lesion developed after injection of contagious bovine pleuro-pneumonia virus. No pus appeared to collect and no swelling burst spontaneously, nor did any beast actually die as the result thereof, but under ordinary pastoral conditions there is no doubt that a large proportion of the cattle would have succumbed. Sporing bacilli of the same type as those cultivated from the serum were recovered in pure culture on surgical removal of some of the contents of the swellings. The second obstacle was that the serum had lost most of its potency and did not protect against cattle plague even in increased dosages; some individuals, even among those injected at the rate of 15-20 c.c. per 100 lb. body weight died of the disease, and a number of others developed severe symptoms. It was subsequently found that concentrations of acriflavine so high as 1-5,000 would not destroy the spores, but as the serum was in any case useless it was decided to discard it and devote one's energies to preventing a recurrence of the catastrophe.

The number of potential bacteriostatic agents is almost unlimited, but on general grounds it was thought advisable first to assess the value of acriflavine, both alone and in combination with carbolic acid. A number of samples of fresh normal serum were therefore set up in three series in unstoppered 50 c.c. bottles, being treated respectively with (i) carbolic alone, (ii) acriflavine alone, and (iii) carbolic and acriflavine, all in a range of concentrations. To each was added two drops (containing many thousand bacteria) of the contaminated serum, and all were incubated at 37°C. Samples were withdrawn and plated on Petri dishes of nutrient agar after one and two months' incubation. The results,

which were quite uniform, were as follows :-

- (i) Carbolic acid, in any practicable dilution (up to 0.6 per cent.) was useless, as it allowed both the streptococci and the sporeers (but few other bacteria) to multiply up to a content of tens of thousands per cubic centimetre.
- (ii) Acriflavine alone prevented the growth of the streptococci but in any concentration of less than 1-8,000 allowed the sporeers, and also a few other organisms, to multiply equally as freely as did the carbolic alone.
- (iii) Acriflavine added to 0.5 per cent. carbolic was remarkably effective. In all dilutions between 1-10,000 and 1-80,000 the average number of colonies per plate (0.1 c.c. of serum) was only fifteen, no significant difference being evident from the highest to the lowest. Nearly all colonies were of sporing bacilli of the type introduced with the seed material, and probably represented no more, and possibly less, than the number originally added.

The bacteriostatic value of the mixture, within the limits of the experiment, could hardly be improved upon. It has not yet been possible to test this efficacy after a lengthy period but the results at the end of about two months' storage at a temperature of 37°C. justified the decision to treat all 1939 serum with a mixture of carbolic acid 1-200 plus acriflavine 1-50,000.

It must be added that when the unsatisfactory behaviour of the serum was first reported the writer was on leave and no body was available to investigate the matter. It must therefore be recorded that when the advice of the medical research staff was asked it was readily given and a good deal of work was done before the writer's return. That the stock of serum could not be saved was due to the nature of the contamination and not to delay in investigating the trouble. The help given by our medical colleagues is hereby recorded with much gratitude.

CAMEL TRYPANOSOMIASIS

In this Report for 1936 brief mention was made of the discovery of ablepharoplastic or akinetoplastic variants of the common camel trypanosome, T.evansi (soudanense). Experiments with a living strain recovered from an infected camel showed that the akinetoplastic property persisted in spite of passing it through a variety of susceptible animal species (gerbil, donkey, ox; horse, camel). The strain, in fact, appeared either to be inherently devoid of, or irrevocably to have lost, its kinetoplast.

Examination of further material from infected camels has now brought an even more puzzling strain to light, namely, one in which the proportion of individuals possessing a kinetoplast fluctuates from only two or three to over ninety per cent. In the original camel (a privately-owned beast which was treated and cured) the trypanosomes were "typical" in the sense that practically all individuals possessed a kinetoplast, but on passage in laboratory animals the above-recorded fluctuation became apparent. The strain has been sent to Dr. C.A. Hoare of London who has made further observations and a joint paper will shortly be published.

D. PUBLICATIONS

Only one scientific paper has been published during the year (recording work carried out in 1936 and 1937) :-

BENETT, S.C.J. & EVANS, J.T.R.	Influence of the Dose of Virus employed in Testing the Immunity of Cattle Vaccinated against Cattle Plague - <u>Jour.Comp.Path.& Therap.</u> , 1938, Vol.51, pp.1-8.
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E. SUMMARY

The usual routine duties continued at approximately the level of last year, low demands for contagious bovine pleuro-pneumonia vaccine being counterbalanced by increased demands for naganol and diagnostic material.

The most noteworthy feature was that nearly the whole of the year's output of cattle plague serum had to be discarded on account of bacterial contamination of a nature that could not have been anticipated.

A new activity has been undertaken, namely, the preparation of foot-and-mouth disease virus for the infection of cattle that are ultimately to be exported; deliberate infection followed by recovery having been found the only way to exclude infected cattle from export consignments.

No deliberate research could be carried out, but two items arose that could not be neglected. The discovery of a second aberrant type of the local camel trypanosome could not be passed over without some study, and the complete loss of the year's output of cattle plague serum necessitated investigation - fortunately successful - of alternative methods of preservation.

One paper was published in a scientific journal.

Khartoum,
8-2-1939.

SAM.

Sgd. S.C.J. Bennett
SENIOR RESEARCH OFFICER,
Sudan Veterinary Service

